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OFFICE OF RADIATION PROGRAMS

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MEMORANDUM

SUBJECT: Industrial Excess Landfill, Final Calculations

FROM: Jon A. Broadway, Ph.D., P.E. *JB*
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TO: Jim Benetti, Chief Radiation Section, Region 5

Attached are results of expanded calculations using the PRESTO waste burial computer code methodology applied to the Industrial Excess Landfill Superfund site in Stark County, Ohio. Using your hypothetical radionuclide inventory data and soil characteristics supplied by Jeff Ross of PRC, Inc., I have made calculations for a 1000 year period following closure of the site. I made four sets of calculations assuming the receptor well point at 100m, 200m, 300m and 800m from the trench. The hypothetically maximum exposed individual is assumed to drink 100% of his water from each well point dug into the aquifer under the site. The individual receives meat and vegetables from locally grown crops exposed to the effluent water from the site. A number of very conservative assumptions (tending to give high dose estimates) were made for these calculations. More realistic assumptions would likely lower, not raise, the estimated doses. As an example of the conservatism built into the calculations, we included radioactivity equivalent to 100 drums of uranium sludge of a composition similar to that from the Fernald plant. We also assumed that all of the burial waste was instantaneously available for leaching from the site immediately upon closure of the site. In spite of these type assumptions, the hypothetical ^{241}Am activity dominated the dose at the 100m point and ^3H dominated the dose at the 800m point and the hypothetical uranium concentration contributed negligibility at all points (See Tables 1 through 4).

The results show the maximum dose to the maximum exposed individual ranges from 5.2×10^{-3} mrem/yr at the 100m well point to 2.5×10^{-3} mrem/yr at the 800m well point. As expected, these incremental doses are predominantly from ingestion of water although inhalation, air immersion and ground surface external exposure are also calculated. The 100m distance was chosen as the closest possible well location (approximate location of monitoring

well #1) and 800m was used since it is the actual location of #8 monitoring well west of the site. An alternate water supply is provided inside of this range so 800m represents the first point where an offsite well for water usage could be constructed.

My conclusion is that the hypothetical radioactive waste inventory, even with its variety of conservative assumptions, would not result in the maximum exposed individual receiving more than 10 microrem per year. This is equivalent to the amount of radiation received by the average individual in about one hour from natural background, and is below the lifetime risk range of 10^{-7} . Since the modeled dose scales as a linear function of the source term, it appears that the hypothetical radioactivity could be several orders of magnitude higher for each of the radionuclides included in this calculation without significant health impact.

Thanks for this opportunity to work with you.

Attachment

cc: David Kee, Region 5
Gary V. Gulezian, Region 5
Stephany De Scisciolo (ANR-458)
Beverly Garcia-Frias (ANR-461)
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TABLE 1

Industrial Excess Landfill
Dose Calculations using PRESTO-CPG/PC for 1000 Years
Following Closure of Site
Individual Located at 100m From Waste Trench

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Nuclide	Initial Inventory at Site Closure [Ci]	Hypothetical Receptor at 100m	
		Year of Max Dose = 543 yr	
		Max Annual mrem/yr	% of Total
³ H	0.3	3.4×10^{-7}	6.6×10^{-3}
¹⁴ C	0.005	1.8×10^{-7}	3.4×10^{-3}
⁵⁵ Fe	0.02	4.0×10^{-40}	7.8×10^{-36}
⁶⁰ Co	0.1	9.6×10^{-34}	1.9×10^{-29}
⁶³ Ni	0.015	1.8×10^{-8}	3.4×10^{-4}
⁹⁰ Sr	0.05	1.6×10^{-10}	3.1×10^{-6}
¹²⁵ I	0.5	0.0	0.0
¹³⁷ Cs	1.0	8.5×10^{-9}	1.6×10^{-4}
^{137m} Ba	1.0	9.8×10^{-8}	1.9×10^{-3}
²²⁶ Ra	0.01	9.0×10^{-4}	17.3
²²⁸ Th	0.1	5.0×10^{-12}	9.7×10^{-8}
²³² Th	0.01	7.1×10^{-13}	1.4×10^{-8}
²³⁴ U	0.1	2.0×10^{-6}	3.9×10^{-2}
²³⁵ U	0.005	4.5×10^{-6}	8.7×10^{-2}
²³⁸ U	0.1	1.8×10^{-6}	3.6×10^{-2}
²⁴¹ Am	0.5	4.3×10^{-3}	82.5
Total all nuclides		5.2×10^{-3} mrem/yr	100%

TABLE 2

Industrial Excess Landfill
 Dose Calculations using PRESTO-CPG/PC for 1000 Years
 Following Closure of Site
 Individual Located at 200m From Waste Trench

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Nuclide	Initial Inventory at Site Closure [Ci]	Hypothetical Receptor at 200m	
		Year of Max Dose = 708 yr	
		Max Annual mrem/yr	% of Total
^3H	0.3	3.2×10^{-7}	7.9×10^{-3}
^{14}C	0.005	1.6×10^{-7}	4.0×10^{-3}
^{55}Fe	0.02	4.0×10^{-40}	9.9×10^{-36}
^{60}Co	0.1	2.9×10^{-37}	7.2×10^{-33}
^{63}Ni	0.015	5.7×10^{-9}	1.4×10^{-4}
^{90}Sr	0.05	3.0×10^{-12}	7.3×10^{-8}
^{125}I	0.5	0.0	0.0
^{137}Cs	1.0	2.3×10^{-10}	5.6×10^{-6}
$^{137\text{m}}\text{Ba}$	1.0	2.8×10^{-9}	6.8×10^{-5}
^{226}Ra	0.01	9.3×10^{-4}	22.9
^{228}Th	0.1	5.4×10^{-12}	1.3×10^{-7}
^{232}Th	0.01	7.1×10^{-13}	1.8×10^{-8}
^{234}U	0.1	1.8×10^{-6}	4.4×10^{-2}
^{235}U	0.005	3.1×10^{-6}	7.5×10^{-2}
^{238}U	0.1	1.7×10^{-6}	4.1×10^{-2}
^{241}Am	0.5	3.1×10^{-3}	76.9
Total all nuclides		4.1×10^{-3} mrem/yr	100%

TABLE 3

Industrial Excess Landfill
Dose Calculations using PRESTO-CPG/PC for 1000 Years
Following Closure of Site
Individual Located at 300m From Waste Trench

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Nuclide	Initial Inventory at Site Closure [Ci]	Hypothetical Receptor at 300m	
		Year of Max Dose = 2nd yr	
		Max Annual mrem/yr	% of Total
^3H	0.3	2.5×10^{-3}	78
^{14}C	0.005	6.9×10^{-4}	21.9
^{55}Fe	0.02	4.7×10^{-12}	1.5×10^{-7}
^{60}Co	0.1	4.1×10^{-9}	1.3×10^{-4}
^{63}Ni	0.015	2.7×10^{-12}	8.6×10^{-8}
^{90}Sr	0.05	1.7×10^{-10}	5.5×10^{-6}
^{125}I	0.5	1.5×10^{-6}	4.8×10^{-2}
^{137}Cs	1.0	1.4×10^{-8}	4.3×10^{-4}
$^{137\text{m}}\text{Ba}$	1.0	3.8×10^{-9}	1.2×10^{-4}
^{226}Ra	0.01	2.4×10^{-9}	7.4×10^{-5}
^{228}Th	0.1	1.9×10^{-11}	6.0×10^{-7}
^{232}Th	0.01	1.4×10^{-12}	4.4×10^{-8}
^{234}U	0.1	2.8×10^{-11}	8.7×10^{-7}
^{235}U	0.005	2.9×10^{-12}	9.1×10^{-8}
^{238}U	0.1	2.6×10^{-11}	8.1×10^{-7}
^{241}Am	0.5	6.0×10^{-8}	1.9×10^{-3}
Total all nuclides		3.2×10^{-3} mrem/yr	100%

TABLE 4

Industrial Excess Landfill
Dose Calculations using PRESTO-CPG/PC for 1000 Years
Following Closure of Site
Individual Located at 800m From Waste Trench

22 Jan 1991
J. Broadway

Nuclide	Initial Inventory at Site Closure [Ci]	Hypothetical Receptor at 800m	
		Year of Max Dose = 3rd yr	
		Max Annual mrem/yr	% of Total
³ H	0.3	1.9X10 ⁻³	79.2
¹⁴ C	0.005	5.2X10 ⁻⁴	20.8
⁵⁵ Fe	0.02	3.3X10 ⁻¹²	1.3X10 ⁻⁷
⁶⁰ Co	0.1	4.9X10 ⁻⁹	2.0X10 ⁻⁴
⁶³ Ni	0.015	2.5X10 ⁻¹²	1.0X10 ⁻⁷
⁹⁰ Sr	0.05	1.5X10 ⁻¹⁰	6.0X10 ⁻⁶
¹²⁵ I	0.5	2.3X10 ⁻¹⁴	9.3X10 ⁻¹⁶
¹³⁷ Cs	1.0	1.3X10 ⁻⁸	5.3X10 ⁻⁴
^{137m} Ba	1.0	5.5X10 ⁻⁹	2.2X10 ⁻⁴
²²⁶ Ra	0.01	2.1X10 ⁻⁹	8.7X10 ⁻⁵
²²⁸ Th	0.1	1.9X10 ⁻¹¹	7.7X10 ⁻⁷
²³² Th	0.01	1.4X10 ⁻¹²	5.7X10 ⁻⁸
²³⁴ U	0.1	2.8X10 ⁻¹¹	1.1X10 ⁻⁶
²³⁵ U	0.005	3.6X10 ⁻¹²	1.4X10 ⁻⁷
²³⁸ U	0.1	2.6X10 ⁻¹¹	1.0X10 ⁻⁶
²⁴¹ Am	0.5	6.0X10 ⁻⁸	2.4X10 ⁻³
Total all nuclides		2.5X10 ⁻³ mrem/yr	100%